Rhinoprosopa lucifer, n. sp.

Related to *aenea* Hull but the pleura are chiefly black, the facial stripe is wider. Hind tibiae black.

Male.—Length 11 mm. Head: the cheeks and sides of face are widely pale yellow; middle of face widely jet black. The sides of the front are orange, broadly opaque black down the middle, expanding to reach the sides of the shining black lunula. Face produced considerably beyond the antennal apex, with a low tubercle below the antennae. Antennae reddish brown, the third joint blackish except at the ventral base; arista black. Pile of front black and long and confined to the top and sides. Vertex black with black pile. Thorax: mesonotum brassy brownish or black, the anterior half brownish-gray pollinose, without definite vittae and with long yellow pile. Humeri, the whole of notapleura, postcalli, and a sharp wide basal margin on the scutellum yellow. Remainder of scutellum dark brown, lighter on the margin, its pile long, sparse, and black, with longer marginal bristles and no fringe. Only the posterior half of the mesopleura is yellow. Abdomen rather slender, especially at the end of second segment, black with yellow markings as follows: all but the posterior margin of the second segment in the middle yellow. Second segment with a pair of long, oblique, anteriorly approximated, bright, central, yellow stripes upon the sides of the segment, each stripe margined anteriorly with opaque black and posteriorly with an opaque triangle. Third segment with similar pattern, the stripes almost confluent anteriorly. Fourth segment with larger, similar stripes which are fused throughout most of their length in the middle. Fifth segment with oblique, transverse, short fascia fused medially. Legs: yellow, the hind femora dark brown on more than the apical half, their tibiae and tarsi very dark brown. Wings: wholly deep brown with slender alulae, equally developed throughout.

Holotype male, Pinas Ecuador, 1,600 meters, July 25, 1941, D. B. Laddey. Two *paratype* males, same data. (Fluke collection.)

ZOOLOGY.—*A folliculinid associated with a hermit crab.*[1]

E. A. Andrews, Johns Hopkins University, and E. G. Reinhard, Catholic University of America.

The folliculinids are a small group of ciliated Protozoa living in colored, chitinoid tests, scarcely visible to the naked eye and firmly attached to various objects in all the oceans of the world. When the animals leave these tests to make others, the old ones persist and are recognizable as representing species and genera.

Hermit crabs drag about deserted snail shells, within which their soft spirally grown hind bodies are protected. That certain folliculinids live attached to the soft bodies of hermit crabs, within the shells of snails, was observed in 1888 by Giard, in France. He saw them as little black spots on the hind body, near the limbs or near the end of the hermit crab *Pagurus bernhardus*, then called *Eupagurus bernhardus*. These specks proved to be groups of folliculinids, which he thought to be well placed to receive currents of water along the hind body. The shape of each test was so peculiar, being pinched in with an upper and lower part, something like a double gourd or gourd-shaped piece of pottery, that he made them representatives of a new genus, *Pebrilla*.

No other mention of this association was made for nearly 50 years, and then, in 1936, Fauré-Fremiet on the coast of France found these same folliculinids associated with the same hermit crab, but also with another, *Clibanarius misanthropus*. He found them standing solitary or in groups of four to seven on the hind body of the crab only, and never upon the inside surface of the snail shell.

Though the pinched-in shape of Pebrilla suggests some outside force, Fremiet observed the animal secreting its test in two efforts, first the posterior part and then, with change of shape and of secretion zone, the anterior part, entirely from within and with no external compulsion. This folliculinid, *Pebrilla paguri* Giard, is known only as

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occurring upon the above two sorts of hermit crabs and as observed by the above two naturalists.

In studying the hermit crab *Pagurus pubescens* Kröyer, living in the shells of the snails *Littorina litorea*, *Thais lapillus*, *Buccinum undatum*, and some others and collected from shallow water in Frenchman's Bay, coast of Maine, between Mount Desert Island and the mainland, one of the authors in 1939, 1940, and 1941 observed blackish spots, which proved to be tests of some folliculinid, scattered over the hind bodies of these crabs. After preliminary study of these objects, involving the preparation of whole mounts and some serial sections of crab abdomens, he turned over this material together with preserved crabs fixed in Gilson's fluid to the senior author for detailed investigation.

This association of folliculinid and hermit crab proves not to be the same as observed in France. The folliculinid is a different species and genus, and the hermit is also a different species from either of those mentioned in France. There are no records of folliculinids on other sorts of hermit crabs, but on one out of a dozen specimens of *Pagurus longicarpus* from Woods Hole, Mass., three or four tests of a folliculinid were found near together on the right side of the antepenultimate segment. These seemed to be *Lagotia viridis*, which is one of several folliculinids that occur in that region. It is common on algae and hydroids, and the few found on the hermit crab may have been stray experimenters.

Examination of a dozen *Pagurus pollicaris*, also from Woods Hole, failed to reveal any folliculinids, and *P. acadianus* from Maine seems likewise free of these Protozoa. However, on five out of six *Pagurus hemphilli* received for examination from the U. S. National Museum and dredged in Cuylers Harbor, San Miguel Island, Calif., in July 1939, there were folliculinids much resembling those on *Pagurus pubescens* from Maine, both in general appearance and in distribution on the abdomen, but they prove to be *Lagotia simplex* Dons as understood by Fauré-Fremiet in 1936. It is not every specimen of *Pagurus pubescens* from Maine that bears folliculinids. Fifty-five adult females, not hosts of *Peltogaster*, showed folliculinids on 39 and none on the rest. Some of the latter were no doubt recently molted crabs and accordingly could not be expected to have attached commensals. The little tests (Fig. 1) stand fixed only to the dorsum and the sides of the hind body and are strikingly more numerous toward the posterior end.

Thus, dividing the abdomen into swollen anterior segments and the terminal part (the latter consisting of the last segment with uropods and telson), we found that in the above 39 there were 89 folliculinids on the swollen region and 237 on the terminal region.

This crowding toward the hind end, which lies far within the spiral of the snail shell, is just the reverse of the distribution of the little bivalves, juvenile *Mytilus edulis*, that were found abundantly attached by byssus threads to the rough anterior free parts of the crab, but very seldom on the hind body.

Why the folliculinids find the terminal region of the crab's body more suitable for attachment than any other arouses speculation. The answer, we believe, may be found in the fact that the apices of the shells inhabited by hermit crabs are generally choked with organic refuse, including fecal material, which must be a rich culture medium for various microorganisms. Since this is pocketed in a relatively stagnant environment, the folliculinids on the terminal portion of the crab's abdomen seem particularly well located to have an abundance of food always at hand.

These folliculinid tests are scattered here and there, often as solitary and quite often as grouped individuals (Fig. 1). The groups are made up of 2, 3, and up to 17 individuals (Fig. 2) and suggest that the swimmers that settle and build have some methods of reaction to one another and are to some extent social. Like many species of folliculinids, these may group themselves in depressed areas of the surface, and often we find them in aggregates along the grooves bounding the last segment, where the largest groups were seen (Fig. 2). Here the swimmers must have settled about the same

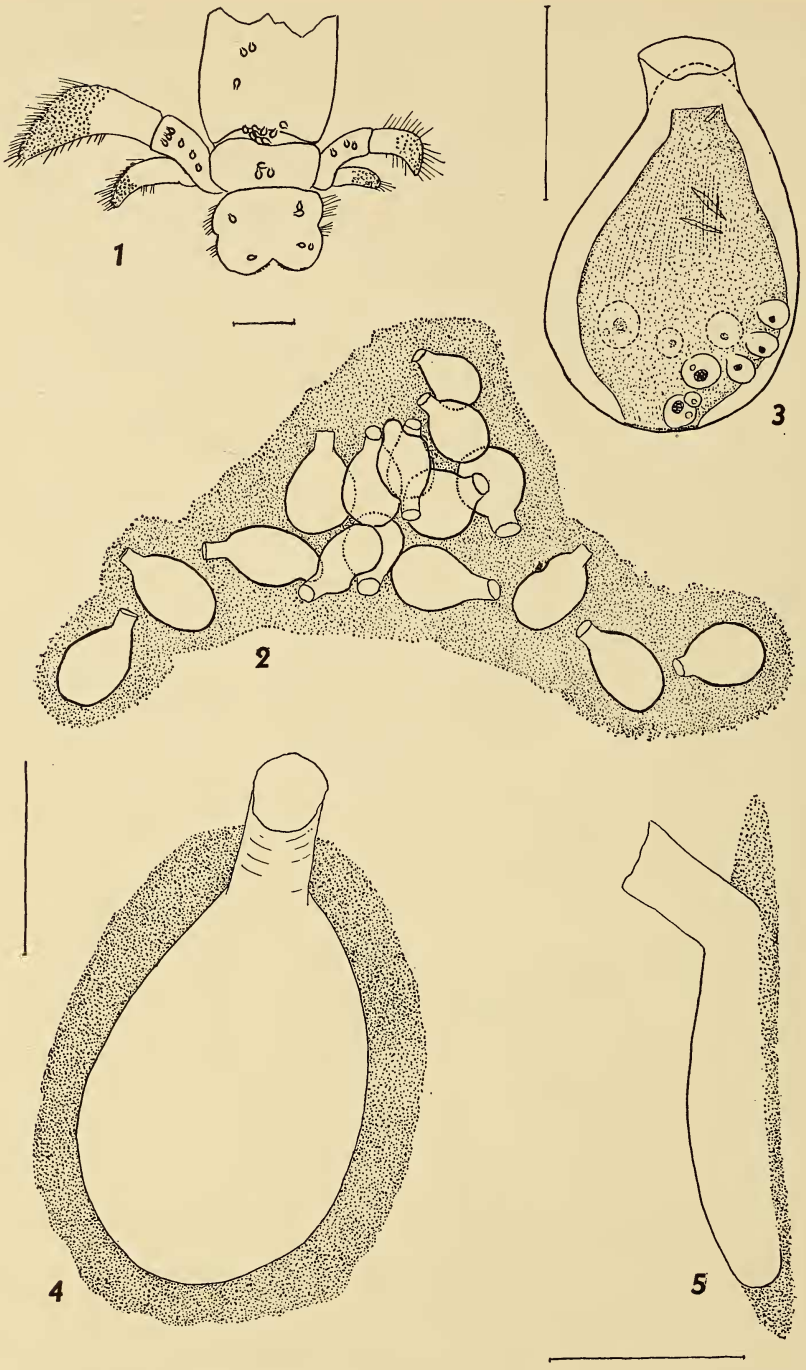

Fig. 1.—Dorsal view of end of abdomen of *Pagurus pubescens* showing distribution of about 30 folliculinid tests. Fig. 2.—Largest group of 17 folliculinids extending in groove outlining telson, all tests connected by basal colletoderm, some built on top of others with outlines distorted from crowding. Fig. 3.—Folliculinid with nine *Pottsia infusorium* parasites projecting from rear portion, and few diatoms in front part. Fig. 4.—Top view of folliculinid test surrounded with halo of cement. Fig. 5.—Profile view of same specimen as Fig. 4.

Each side line represents 100μ except in Fig. 1, where it represents 1 mm.

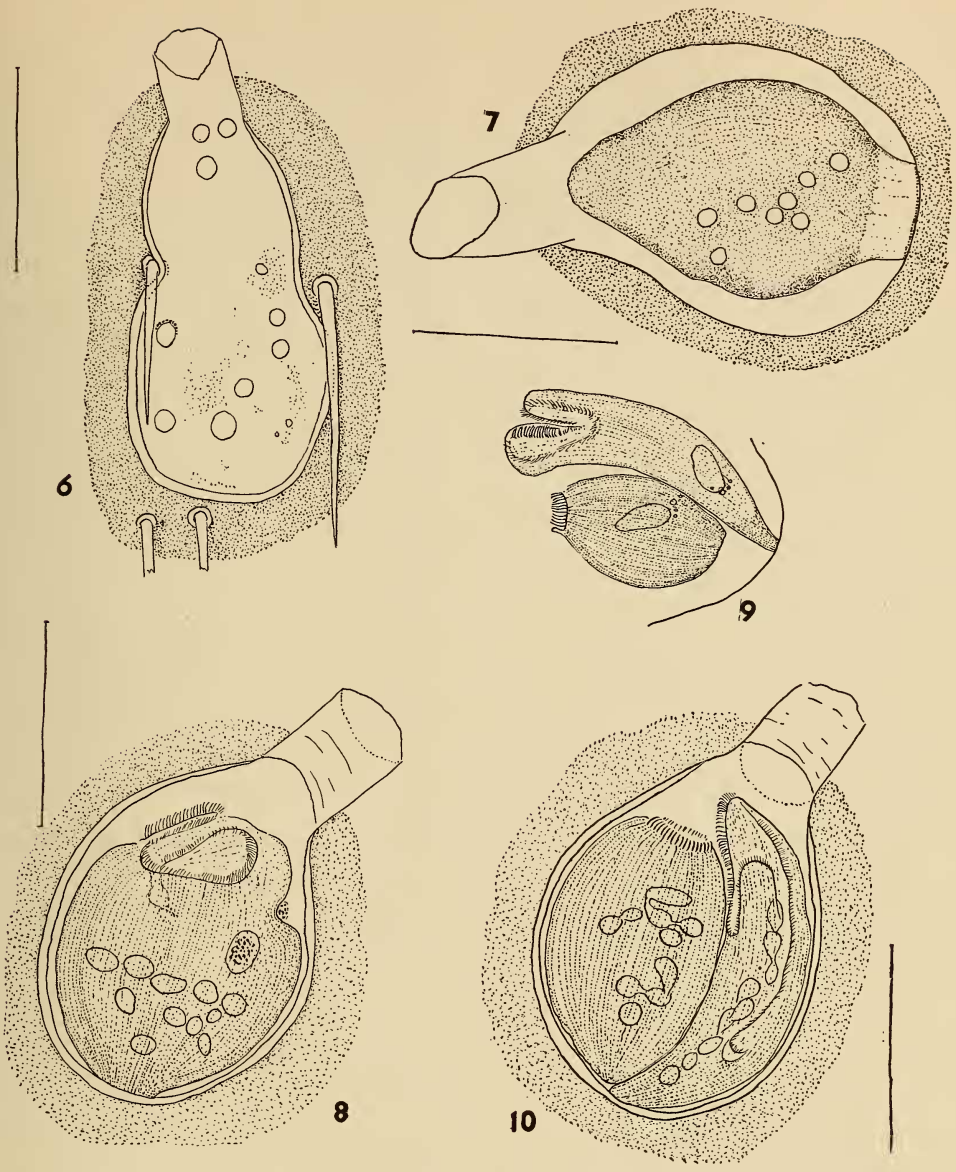

Fig. 6.—Dorsal view of folliculinid test distorted by pressure against setae of surface of last pleopod of *Pagurus pubescens*. Contents of test reduced to scattered nuclei, chiefly. Outline suggests that of *Lagotia*. Fig. 7.—Partly preserved folliculinid with wide base of attachment to test. The wide stalk abnormally cleared of granules except at the attaching surface. Eight nuclei in view. Fig. 8.—Ventral view of folliculinid fixed in Gilson's liquid, showing unequal peristomial lobes, pharynx, and part of gullet; with 11 unequal nuclear lobes and large fecal vacuole approaching small remnant already discharged. Fig. 9.—Two folliculinids fixed in Gilson's liquid in partly destroyed test, each with one macronucleus and several micronuclei. They are the separated anterior and posterior halves of one that divided crosswise; the one on the right retains its contact with the test and is developing unequal lobes; the one on the left was the anterior half and is free from the test; its terminal membranella crown is that of a free-swimmer, but there is a small protoplasmic protrusion near it. Fig. 10.—Ventral view of folliculinid test containing two results of recent fission; the anterior part to the left has terminal crown of a swimmer and 10-lobed nucleus; the posterior part, to the right, retains basal attachment, has a 9-lobed nucleus and two unequal peristomial lobes, with the nascent pharynx still at the posterior third of the body.

Each side line represents 100μ. All figures (1–10) are of *Platyfolliculina paguri*, n. sp.

time and crowded as close as possible to others, and some even settled on top of those already in place. Such overlying individuals show irregular outlines, since the sides of their tests were hampered by contact with the necks of the tests they sat upon. It will be noted that the colony has a dense center where they parked so closely as to leave no vacant spaces, just as is the habit of *Metafolliculina andrewsi*.

These tests show no common orientation; even in closely crowded groups the members that stand side by side have axes in various directions. Each test is a very flat simple flask with short neck, and it is surrounded by a halo of cement that fastens it to the surface of the crab (Figs. 4, 5). When two or more settle near together the cement of all binds them together by a flat membrane called colletoderm by Wright in 1859. Peeling this from the crab removes a group as one mass.

It is notable that many of these tests are empty, so that good specimens of the animal are not readily found. One group of ten had eight empty. To be sure, it is known that folliculinids may swim away and leave empty tests, but here we find evidences of death of the animal, such as remnants of protoplasm with groups of nuclei (Fig. 6). That some of the many empty tests may be the results of attacks by parasites is suggested by facts to be presented later on in this paper.

Proceeding now to a detailed description of these folliculinids associated with *Pagurus pubescens*, we consider first the test and then the animal, not observed in life.

By reflected light the tests are soot-black, but by transmitted light pale green. Each is a flat, wide sac with insignificant neck that lacks a special collar at its mouth. The floor of the sac is quite flat and the roof but slightly arched. The sac adheres by a thin layer of cement under its floor and extending 20–50μ as a halo around the floor of the sac. The underlying cement may rise up posteriorly to the top of the sac roof. The short simple neck has a thin wall, while the sac seems to have a thick wall, but this is the optical effect of the curvature of the sides, which in a horizontal distance of 5–6μ descend 25–30μ, the top and bottom views suggesting outer and inner boundaries of the wall. That is, where the greatest diameter of the sac is 125μ the diameter of the floor is 115μ—the overhanging sides simulating a thick wall.

As the sac is so flat, top and bottom views are readily seen but profiles scarcely ever. In bottom views the sharp line of junction of side and floor is striking. Actual longitudinal sections of the test give the appearance of a test tube with blunt bottom and upturned mouth end. The material of the test looks homogeneous except that in the cement and sometimes in the walls of the neck there are minute particles, some of which are the original subpellicular granules (protrichocysts of Klein) discharged and more or less swollen and fused to make all the test and cement.

The flimsy necks show various lengths and angles of rise from the floor of the sac, but as side views are rarely seen the measurements of neck length are not exact. Views down the neck sometimes suggest valves, but none was demonstrated. Rarely is the thin mouth edge thickened slightly as a 5μ rim.

The range in size in 25 measured tests is as follows:

Total length	188–238μ
Sac length	138–188
Neck length	35–75
Sac width	90–150
Neck width	38–60
Mouth width	30–63

As estimated by focusing, the depth of the sac is often but 25μ and rarely 50μ, while in paraffin sections it was measured as 25, 28, 35, and 38μ.

The tests are not so strictly symmetrical as in many other folliculinids, and there are some monstrosities. One had a neck from a sac of 125μ length extended to a total length of 113μ. This resulted from the fact that its first portion of 50μ length was followed by a secondary extension of 63μ off at a large angle.

Straight extensions of necks are common in some folliculinids. The sides of the sac are not infrequently indented, and usually this has arisen from resistance of setae on the

shell of the hermit crab, or from necks of other tests, as in Fig. 2. When, as in Fig. 6, the swimmer settled between setae too near together its test was distorted on opposite sides so as to somewhat suggest the pinched-in form of *Pebrilla paguri* found on hermit crabs in France.

Knowledge of the animal within the test is hampered by effects of parasitism and methods of fixation of the crabs. Though one remnant had a length of 250μ, most were strongly contracted down into the sac with the peristomial lobes but poorly preserved. The left lobe was considerably bulkier than the right. What was seen of the pharynx was not deep and possessed few spirals.

Nuclei appear clear in dead remnants and as dark-stained spherules after borax-carmine or haematoxylin. Generally 9, but up to 13 in number, are present. Rarely seen connected, they are of unequal mass, 5–15μ in diameter. Each nuclear lobe is closely surrounded by a layer of granules. Accompanying these macronuclei were sometimes darkly staining unequal spherules about 1–2μ in diameter and deemed to be micronuclei. Longitudinal pigment bands were counted as 30–35 in dorsal view. Food vacuoles were seen and some diatoms within the protoplasm, anteriorly; also fecal vacuoles. What is of import is that where the animal had not been separated from the sac it was attached posteriorly by a broad base, 25–45μ wide (Fig. 7).

Seeking a name for this folliculinid associating with *Pagurus pubescens*, we find that its multiple nucleus places it in the Eufolliculininae where its wide flat sac, short neck, and broad base of attachment of the animal bring it near to what Hadzi, in 1938, called *Platyfolliculina sahrhageana*. Hadzi found in the Adriatic two undescribed forms in the subfamily Semifolliculininae with broad bases of attachment; thinking this important he worked over the illustrations given in 1917 by Sahrhage when describing division in what he thought *Folliculina ampulla* (a name applied to many different species). Hadzi concluded that Sahrhage's illustrations should be taken as representative of a new genus, *Platyfolliculina*, to be called *P. sahrhageana*. He estimates the dimensions to be:

Total length of test	137–237μ
Breadth of sac	91–109
Breadth of neck	34–50
Width of mouth about	43

The extended animal was 243–250 by about 30 but when retracted 85–132 by 59–33μ. The macronuclei were generally six in number and up to 17μ in diameter; and the micronuclei up to five in number.

Sahrhage's species came from algae and piles in Kiel Harbor, but ours on *Pagurus pubescens* has much resemblance to it. Moreover, in one of these crabs fixed in Gilson's liquid, two tests were found containing stages soon after division, as described by Sahrhage.

In the first (Fig. 9) two animals occur side by side, each with one macro- and several micronuclei. This is evidently a stage immediately after the moniliform nucleus condensed into a rod that divided into anterior and posterior halves, as the protoplasm pinched in ventrally to separate an anterior from a posterior half. Of these the posterior stands attached, while the anterior has slipped down along the side of the posterior half and stands beside it and free.

In the later stage (Fig. 10) the macronuclei have increased to the normal number while the original anterior half still remains alongside the posterior half preparatory to swimming free; the posterior half, on the right of the illustration, is perfecting its unequal membranella-bearing lobes, though as yet the opening of the infundibulum is far back in the posterior third of the animal and will need to be brought forward to function. In general, as here, the ontogeny of any folliculinid starts as a rodlike form, *I*, then this splits deep to form almost a *V*, and later elongates the stalk to fashion a *Y*-form the arms of which are of different lengths in different species and in different phases.

Provisionally, we assign this folliculinid on *Pagurus pubescens* to the genus *Platyfolliculina*, but as the nuclei are more numerous, the necks longer, and the sacs wider than in *P. sahrhageana* it seems to belong

to a new species here named **Platyfolliculina paguri.**

These platyfolliculinids associated with *Pagurus pubescens* live well protected in the restricted, dark spaces of the snail shell, yet as they multiply there it is evident that adequate food is present for them and for other ciliates also residing there, such as the large branched colonies of vorticellids and upstanding tube dwellers seen in 7μ sections as 45μ long *Cothurnia.*

When the animals are present in their tests they frequently bear at the posterior part (Fig. 3) several spheroidal protrusions, 4–30μ in diameter, each with a large nucleus 4–10μ wide and often also with a smaller embryo cavity 2–5μ wide, external to the nucleus.

That these projecting cells are actually parasites fastened to the folliculinid is certain when they are compared with the results of Chatton and Lwoff, who in 1927 described a new and remarkable suctorian that lives as parasite upon two species of folliculinids and two species of vorticellids. When mature these parasites project just as in the folliculinids we find upon *Pagurus pubescens.*

These authors, in 1924, found that *Folliculina ampulla* was badly infested with these parasites in the aquaria at Monaco, while the rare *F. elegans* had none. Also *Folliculina ampulla* brought from Samoa and from Woods Hole, Mass., by F. A. Potts, lecturer at Cambridge, showed these parasites. These suctoria, named *Pottsia infusorium,* are peculiar in the group of acinetans in that the embryo released from the cavity of the adult in which it was formed by budding has three bands of locomotor cilia as well as terminal sucking tubes by which it anchors itself to the body of the folliculinid and grows to maximum size by drawing out liquid from the host. As many as 22 were seen on one folliculinid, and these authors think that greater numbers kill the host folliculinid, after which they gradually perish within the host's test. This may account for the many emptied tests seen on *Pagurus pubescens.*

Finding *Pottsia infusorium* as parasite on these folliculinid associates of the hermit, *Pagurus pubescens,* thus adds Maine to their previously recorded geographical distribution, Samoa, Monaco, and Woods Hole, and also adds to the previously recorded hosts they attack, i.e., *Folliculina ampulla, F. elegans, Cothurnia ingenita,* and *C. socialis,* this folliculinid on *Pagurus pubescens.* Moreover, this same parasite was seen on a few *Parafolliculina amphora* and *Metafolliculina andrewsi* in September, 1941; on the west shore of the Chesapeake Bay, north of Baltimore.

In passing, we note that Chatton and Lwoff previously discovered a flagellated organism, *Sporomonas infusorium,* living as a parasite in *Folliculina elegans,* as well as in *Vorticella,* in the aquaria at Banyuls and in *F. ampulla* from Woods Hole. In the folliculinid this *Sporomonas infusorium* grows to be a mass of 70μ diameter before it escapes from the folliculinid to sporulate inside the test.

The folliculinid these authors call *F. ampulla* is a multinucleate form with long spirally reinforced neck and may well be what Hadzi later called *Metafolliculina andrewsi.*

Whether *Platyfolliculina paguri* occurs also in other habitats remains to be found out. It is not the only folliculinid in this habitat, for on one specimen of *Pagurus pubescens* there were found two long, slender folliculinids of some other kind. One was fast to the right side of the fourth segment of the hind body, pointing downward, and the other was well protected on the chela closely surrounded by heavy conical spines. These two seem to represent some undescribed form.

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ZOOLOGY.—*On a species of pycnogonid from the North Pacific.*[1] JOEL W. HEDGPETH. (Communicated by CLARENCE R. SHOEMAKER.)

The species of pycnogonid here described is based on specimens named and designated as types by the late Dr. Louis Giltay, and deposited as such in the United States National Museum. After this paper was submitted for printing, Dr. William A. Hilton published preliminary diagnoses of some new species in *Colossendeis*, the genus concerned, including one under the same name.[2] Although the diagnosis is vague, and incorrect in one detail ("ocular tubercle . . . not pointed," p. 3), the specimens consulted undoubtedly are the same species and were evidently labeled by Dr. Giltay. As it may be many years before descriptions and figures of these numerous preliminary species are published, I have deemed it wise to proceed with this paper in order to clarify the status of at least one of these species. Inasmuch as all the material examined appears to have been labeled by Dr. Giltay, his type designation, supported by the description and figure herein, should not be abandoned in favor of that in a brief diagnosis. Although it is impossible, of course, to credit Dr. Giltay with the authorship of this species, it is unfortunate that his label name was not acknowledged in the preliminary diagnosis. The type specimens were taken by the U. S. Bureau of Fisheries steamer *Albatross*.

Genus **Colossendeis** Jarschinsky
Colossendeis tenera Hilton[2]

Holotype.—Male; *Albatross* station 3346, 44°31′ N., 124°52′ W., 786 fathoms, September 22, 1890.

Paratypes.—Male; *Albatross* station 3074, 47°22′00″ N., 125°48′30″ W., 877 fathoms, June 29, 1889. Three females; *Albatross* station 2859, 55°20′ N., 136°20′ W., 1,569 fathoms, August 29, 1888.

Description.—Trunk slender, unsegmented, lateral processes separated by spaces somewhat narrower than their own diameter, except the posterior pair, which appears to be more widely separated than the preceding pairs. The eye tubercle is very high, narrowly conical, and tapers to a small blunt point. The eyes are basal, large, but indistinctly pigmented. The anterior pair is larger than the posterior.

Proboscis slender, straight, slightly dilated near the distal third and slightly expanded at the tip. It is markedly longer than the trunk.

Palpus covered with minute setae, especially the distal joints. Basal joint much broader than long; second joint straight, sticklike; third joint not much longer than wide, slightly curved; fourth joint little more than half as long as second; fifth joint shorter than sixth; seventh shorter than wide; eighth about three times as long as seventh; ninth joint slightly longer than eighth.

Abdomen papilliform, directed upward at an angle and longer than the last lateral processes.

Oviger: First and second joints subequal; third joint about half again as long as first; fourth and sixth long, nearly straight, subequal, or sixth slightly longer than fourth in the male; fifth joint about half as long as fourth. Terminal segments diminishing in length distally, with 7 to 10 flat, finely denticulated spines in the largest rows. Terminal claw heavy, curved, about four times as long as basal width.

Third leg: Coxae subequal. Femur slightly

[1] Received March 30, 1943.

[2] HILTON, W. A. *Pycnogonids from the Pacific.* Pomona Journ. Ent. and Zool. **35** (1): 2–4. 1943.